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EMBOSSING ROLLER FOR THE PRODUCTION OF TISSUE ARTICLES  
[Prägewalze zur Herstellung von Tissueartikeln]

Ralf Eisenschmidt

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INVENTOR	(72):	Ralf Eisenschmidt
APPLICANT	(71):	A.E. Ungricht GmbH & Co. KG
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## Description

The present invention pertains to an embossing roller for the production of tissue articles with the properties of the main clause of Claim 1.

In order to produce tissue articles, for example, in particular paper tissues, kitchen towels, toilet paper, napkins, place coverings, hygienic towels or such, as a rule at least two layers of a cellulose-like material are bonded together; in this case, the minimum of two layers forming the tissue article are bonded together by embossing with one pair of embossing rollers located in a calendar.

For example, document DE 196 26 997 describes an embossing method of this kind for the production of a multiple layer tissue article, wherein the particular layers to be bonded together are first placed one above the other and thereafter the layers are embossed by means of a pair of embossing rollers, so that the cohesion of the layers forming the tissue article is obtained due to a mechanical deformation in the region of the embossing caused by the engraving. The pair of embossing rollers used in the known method calls for a roller engraved according to a specified pattern, whereas the opposing roller of the pair—which together with the engraved roller forms the pair of embossed rollers—is a non-engraved roller.

In order to ensure in the state of the art technology, that the embossed surfaces or points are positioned more closely toward the middle when viewed over the cross section of the embossed tissue article, the known method requires special engraving such that immediately after the embossing, a deformation of the embossed surfaces or of the embossed points will occur in the interior of the embossed tissue article due to the adhesion produced by the engraving.

In the known method and with the pair of embossed rollers used therein, there is a possibility that the adhesion necessary for the shifting of the embossed points or embossed surfaces into the interior of the tissue article will not be completed within the required time, which amounts to fractions of a second.

Therefore, this will mean that the tissue article will have to be pulled off from the engraved embossing roller with a relatively strong force, which in this case can very easily result in tearing of the embossed tissue article, which may then be followed by an undesirable wind up of the remaining sheet of tissue article onto one of the rollers of the roller pair. Therefore, in the known method one must always count on production malfunctions.

The present invention is based on the problem of defining an embossing roller for the production of tissue articles, in particular for the production of paper tissues, kitchen towels, hygienic articles, napkins, toilet paper and/or place coverings, of the kind described above, which will allow a reproducible embossing of the tissue articles while effectively preventing production interruptions.

This problem is solved according to the invention by an embossing roller with the characterizing properties of Claim 1.

The invented embossing roller for the production of tissue articles, in particular for the production of hygienic articles, paper tissues, kitchen towels, toilet paper, cosmetic tissues, napkins and/or place coverings, provides that in this regard, two engraved rollers together form a pair of embossing rollers. On its surface, each roller is equipped with at least one engraving protruding above the roller surface, and the rollers are aligned with respect to each other during the production of the tissue article, so that the embossing gap needed for the common embossing of the layers forming the tissue articles is formed by the mutually aligned, radially outer engraving sections of the rollers. In other words, the invented embossing roller composed of the two engraved rollers cooperating with each other and positioned in pairs, causes the embossing and the resultant deformation of the layers of the tissue article placed one upon the other in such a manner that the embossing gap is formed exclusively by the mutually aligned, radially outer engraving sections of the engraving located on the two rollers. This means that each embossing point or each embossing surface—which is hereinafter also called the embossing zone—align

with each other and are located in the middle when viewed across the thickness of the embossed tissue article.

The embossing roller according to this invention has a number of advantages. The first prominent advantage is that in comparison to the known state of the art, with the invented embossing roller not specially designed and adhesive embossing zones are needed, since due to the special alignment of the engravings on the two rollers relative to each other as described above, the layers of the tissue article of both the top surface and also on the lower surface are necessarily deformed inward at the same sites to form the embossing zones, which as a result means that the forces necessary to withdraw the embossed tissue article from each roller are identical in size, but are oppositely directed, so that these forces cancel each other out. In turn, this then means that in the invented embossing roller, the undesirable wind up of the embossed tissue article onto one roller of the roller pair is thus necessarily and particularly prevented in a simple manner, so that malfunctions and breaks in the production, such as a tear in the embossed tissue article and/or an undesirable wind up of the embossed tissue article onto one of the two engraved rollers, is prevented.

In addition, the invented embossing roller has the added advantage that both embossing rollers are preferably identically engraved, in particular the rollers experience wear uniformly, which is not the case in particular when, as in the described state of the art, one engraved roller is paired to a non-engraved roller to form the embossing gap necessary for the embossing. Furthermore, surprisingly it was found that in the case of this kind of embossing rollers, embossed zones pointing inward, formed identically from the top surface and also the lower surface of the embossed tissue article, which as described above, are located across the thickness of the embossed tissue article primarily and preferably exclusively in the middle region, and these embossed zones cause an outstandingly strong bonding of the individual layers of the tissue article, so that these layers are durably bonded with each other by means of a special

deformation of this kind, even if the layers are not subsequently glued to each other. This means that in the case of the tissue articles produced by using the invented embossing roller, a partial or complete detachment of individual layer regions or of entire layers was not observed, even under extreme usage conditions. Furthermore, the tissue articles produced with the invented embossing roller have identical properties, both on their top surface and also on their lower surface, since these two surfaces are identically shaped due to the specific arrangement of embossing zones, so that the top surface does not differ from the lower surface of an article embossed in this manner, neither with regard to their properties, in particular with regard to smoothness, of touch, of softness, of absorption and/or of strength, provided an identical material is used for the upper and the lower layer. Therefore overall the invented embossing roller contributes to the simplification of production and to an improvement in the properties of the tissue articles embossed therewith.

Basically, the embossing roller according to the invention used for embossing as a pair of engraved embossing rollers can have an engraving which protrudes above the roller surface and which is aligned to the other roller so that during embossing, only the radially outer engraving sections form the embossing zones of the embossing gap. A particular advantage, especially under consideration of the production costs of the invented embossing roller, is when each roller has an engraving which is composed of a plurality of webs located on the surface of the roller. Webs of this kind can be produced under relatively favorable conditions due to the usual engraving techniques, and an important advantage of such web-like engravings is that the wear on these web-like engravings is reduced significantly in comparison to the specially shaped engravings of the state of the art.

In an additional embodiment of the invented embossing roller, the engravings formed as webs on the roller surface of each roller are positioned in a spiral shape, and webs of this kind running in a spiral shape produce groove shaped embossed zones in the embossed tissue article. A configuration of this

kind of spiral shaped webs on the roller surface of each roller has the important additional advantage that the wear on the engraving is minimized and in particular also that in this case an adjusting of the engravings of the first roller relative to the second roller of the pair of embossing rollers is kept to a minimum.

Basically it is possible that the webs which are positioned on the roller surface of each embossing roller and which extend in a spiral shape across the roller surface, are configured as line-shaped and thus are solid webs. A particularly suitable and favorable enhancement of the invented embossing roller provides that in this regard, the webs are formed from a plurality of web elements, wherein sequential web elements are separated from each other by radially inward pointing recesses. An embodiment of the invented embossing roller of this kind can be produced at a relatively low cost and allows the formation of relatively small surface area embossing zones, so that due to the thickness and size of the embossed zones, the feel and in particular the softness of the embossed tissue articles are not adversely affected, but nonetheless it is assured that the embossed layers remain permanently bonded to each other by the plurality of the quite small area embossed zones.

Fundamentally with regard to the invented embossing roller there are two possibilities for the configuration of the engravings onto the surface of the two embossing rollers, which together form the pair of embossing rollers.

The first possibility provides that both embossing rollers have different engravings, and these engravings which are located on the roller surface of each of the invented embossing rollers, are formed preferably from the webs described above. In this case the axial separation of neighboring webs of the webs located on the surface of the one embossing roller is greater than the axial separation of neighboring webs of the webs located on the surface of the other embossing roller, with the result that the density and/or the size of the embossed zones of the tissue article embossed with this kind of

embossing roller pair can be modified and in particular, reduced. Due to an axial shifting of the one embossing roller relative to the other embossing roller of the pair of embossing rollers, additionally also the density and/or the size of the embossed area in the tissue article embossed with this kind of embossing roller pair can be varied to the particular requirements, so that the versatility of this kind of embodiment of the invented embossing roller is increased.

With regard to the embodiment of the embossing roller described above it is a particular advantage when the axial separation of neighboring webs on the roller surface of the one embossing roller is greater by a factor 1.5 to 2.5 than the axial separation of the neighboring webs on the surface of the other embossing roller, so that the radial outer engraved sections of the embossing rollers during the embossing process only partly align with each other to form corresponding, small surface area embossed zones. A reduced number of small area embossed zones will then cause an increase in absorbance and a very pleasing softness in the embossed tissue article.

In the second possibility, each of the two invented embossing rollers which form the pair of embossing rollers has on its surface an identical engraving, so that in this case the embossing gap needed for the embossing is formed by the full surface area of the mutually aligned radially outer engraved sections of the embossing rollers. With this kind of design embodiment of the invented embossing roller, in particular tissue articles can be produced in which the layers to be bonded together will have a particularly durable and permanent bonding with each other.

An additional, particularly favorable embodiment of the invented embossing roller refers back to a kind of roller pair in which each embossing roller has at least one spacer ring extending across the circumference, wherein the spacer ring relative to the engraving is pointing radially farther outward. In this case, these two embossing rollers forming the roller pair are positioned during the embossing process so that the spacer rings located outside of the article to be embossed touch each other during the

embossing, so that due to the radial outward pointing dimension of the spacer ring relative to the radial height of the engraving, the thickness of the embossing gap is necessarily defined. In particular when at least one spacer ring is located on each embossing roller at each axial end, in a design of this kind of the pair of embossing rollers, the complicated adjusting and fine-tuning of the embossing gap can be omitted during the embossing process, since the embossing gap is necessarily formed by the spacer rings in contact with each other during the embossing. Surprisingly it turns out that the wear on the engraving nearly corresponds to the wear on the spacer rings, so that even over an exceptionally long operating time, the dimensions of the embossing gap remain constant and thus with this design embodiment of the invented embossing roller a uniform embossing is possible over a long operating time.

Basically the radially outward pointing dimension of the spacer ring relative to the engraving is governed according to the thickness and the number of the layers of the tissue article to be embossed with each other, and by the desired position of the layer of the embossed zones relative to the thickness of the embossed tissue article.

Now, if in the design embodiment described above, the radially outward pointing dimensions of the spacer ring provided on each embossing roller are identically configured, then the embossing zones created by the engraving are exactly in the middle, when viewed across the thickness of the embossed tissue article. However, if the spacer rings provided on the end of the one embossing roller have a smaller radially outward directed dimension than the end of the other spacer rings provided on the other embossing roller of the roller pair, then the position of the embossed zones shifts relative to the thickness of the embossed tissue article, from the middle in the direction of the embossing roller whose spacer rings have a greater radially outward pointing spacing. Therefore it is possible to change specific properties of the top surface or of the lower surface of the embossed tissue article, in particular the softness, feel, the absorptiveness and/or the strength of the tissue article.

If the invented embossing roller is used for embossing of two-layer to eight-layer tissue articles, then it turns out that preferably each spacer ring should extend radially outward relative to the engraving by 0.2% to 10%, relative to the radially outward pointing dimension of the engraving. In particular, the spacer rings have a radially outward pointing dimension which extends 0.005 mm to 0.1 mm farther outward than the engraving provided on the surface of the embossing roller. Tissue articles produced in this manner have outstanding properties, in particular also an excellent wet- and/or dry strength.

Basically with the invented embossing roller it is possible to configure the cross section of the webs or web elements forming the engraving in any manner, however, rectangular or trapezoidal shaped cross sections of the webs or of the web elements are preferred. In this regard, the engraving formed as a web for each roller will have a plurality of radially outward web sections running parallel to the axis, wherein during the embossing, the web sections of the one roller relative to the web sections of the other roller are aligned to each other so that these web sections align with each other to form the embossing gap and thus during embossing of the tissue article, the desired, internal embossing zones are formed.

Design embodiments of the invented embossing roller as discussed above have a high wear resistance, in which each web has an axial width of between 0.2 mm and 1.4 mm, preferably an axial width of 0.5 mm to 0.9 mm. In this case, these webs allow the production of cohesive embossed zones which will allow a particularly durable bonding of the individual layers with respect to each other, especially in the case of multiple layer tissue articles.

In particular when the invented embossing rollers have the described recesses between neighboring webs whose axial dimension varies between 1.0 mm and 10.0 mm, preferably between 1.2 mm and 1.5 mm, a design embodiment of this kind has outstanding properties for the production of sharp contours, cohesive embossed zones, since these recesses with the dimensions specified above do not become fouled so quickly due to abrasion of the layer material.

Basically, with the embossing roller according to the invention, the radial height of each web is governed by the number and also by the individual thickness of the layers to be bonded by the embossing, and also by the thickness of the tissue article to be produced, and the radial height of each web should vary preferably between 0.1 mm and 1.5 mm.

As was already described above with regard to one design embodiment of the invented embossing roller, the preferred embodiment of the embossing roller will have an engraving designed as spiral-shaped webs, wherein these spiral-shaped webs are aligned at an angle  $\alpha$  between 35° and less than 90° relative to the roller axis, and preferably between 45° and 85°. It turns out in this case that webs aligned obliquely to the roller axis have a high wear resistance, which is attributable to the fact that each point of the web experiences uniform wear during the operating time of the embossing rollers.

As already disclosed above, in one preferred embodiment of the invented embossing roller, each web is designed with a rectangular cross section. This rectangular configuration of the web will ensure that the radial outer web section will produce sufficiently large embossed zones, and that a high wear resistance of the engraving is obtained.

If the invented embossing roller is used for the manufacture of tissue articles in which only selected regions have embossed zones, then a design of the invented embossing roller can be used in which at least one roller of the roller pair has at least one section in which the roller surface is free of any engraving. In this case, this at least one section is positioned according to a preset pattern between the outward pointing engraving and in particular between the plurality of the webs, so that during embossing with use of this kind of embossing roller, the entire surface of the tissue article will not be affected with embossed zones, but rather only selected regions of the tissue article will be equipped with embossed zones, whereas in other regions the layers forming the tissue article are not bonded together.

In particular, the non-engraved sections described above on the at least one embossing roller amount to between 20% and 70% of the roller surface of the particular roller, wherein a configuration of this kind for the invented embossing roller is used in particular for the production of napkins, hygienic towels or paper tissues.

Preferably for the production of tissue articles, a pair of embossing rollers is used in which each invented embossing roller has a roller diameter of between 100 mm and 1000 mm, preferably between 200 mm to 500 mm, and these rollers can still be manufactured in a relatively low cost manner, and moreover, have an extremely long operating life in the production of tissue articles.

With regard to the thickness of the engraving provided on the invented embossing roller, it turns out that the engraving density is governed by the desired locking of the layers forming the tissue article and also by the particular use of the tissue article. Particularly suitable engravings will have in particular the webs or web elements described above, in which the embossed zones generated in this manner take up a surface area between 0.1% and 60%, preferably between 10% and 35%, relative to the total surface area of the embossed tissue article.

In particular, when the invented embossing roller is equipped on its surface with this kind of engraving, so that the number of embossed zones created thereby is varied between 5 and 90, relative to 1 cm<sup>2</sup> surface area of the embossed tissue article, then durable tissue articles reinforced by embossing can be produced. In this embodiment of the invented embossing roller, relatively small surface area embossed points are created, preferably with between 20 and 70 embossed points per cm<sup>2</sup> surface area, as interior embossed zones, so that due to the plurality of these embossed points, in particular a mechanical interlinking and hooking of the individual layers is assured. In turn, this means that this kind of embossed tissue article will have a high mechanical strength of the mutually bonded layers, so that in

this case tissue articles can be produced which have in particular the non-embossed sections described above.

It has already been discussed above that the invented embossing roller is used as a pair of embossing rollers for the production of tissue articles, wherein optionally each roller of the roller pair has a precisely identical engraving or an engraving which differs only in the axial spacing of the webs, as these two possibilities were described above.

The term 'tissue article' within the framework of the present description of such articles, means those articles in which at least two layers, in particular two paper layers, are bonded together by a mechanical deformation of selected zones of the layers, wherein if necessary, these layers can also be glued.

Favorable embodiments of the invented embossing rollers are presented in the dependent claims.

The embossing roller according to the invention as described above will be specified in greater detail below based on four design embodiments in association with the Figures. In this regard, the first embodiment is based on Figures 1 to 4, the second embodiment is based on Figures 5 to 8, the third embodiment is based on Figure 9, and the fourth embodiment is based on Figures 10 and 11, and in all Figures 1-11 the same subject matter is identified with the same reference numbers.

Specifically we have:

Figure 1 a schematic, partial side view of a first design embodiment of two embossing rollers arranged in one pair of embossing rollers;

Figure 2 a modification of the mantle of the roller illustrated in the bottom of Figure 1;

Figure 3 a section, presented in top view, of the article embossed with the roller pair shown in Figure 1;

Figure 4 a cross section along line A-B in Figure 3;

Figure 5 a schematic, side view of a second design embodiment of an embossing roller;

Figure 6 a modification of the mantle of the embossing roller illustrated in Figure 5;

Figure 7 a section of the article embossed with the roller shown in Figure 5;

Figure 8 a cross section along line A-B in Figure 7;

Figure 9 a schematic side view of a third design embodiment of the embossing roller, presented as a roller pair;

Figure 10 a schematic, partial side view of a fourth design embodiment of two embossing rollers arranged in a pair of embossing rollers;

Figure 11 A section shown in top view of the article embossed with the roller pair illustrated in Figure 10.

Figure 1 presents a first design embodiment of the invented embossing roller, wherein one pair of embossing rollers is illustrated and is composed of an upper embossing roller 1 and a lower embossing roller 2.

The upper embossing roller 1 is equipped with an engraving designed as a web 3, and this web 3 extends as an uninterrupted web line in a spiral shape across the roller surface of the upper embossing roller 1. The uninterrupted webs 3 in the design embodiment shown in Figure 1 are aligned at an angle  $\alpha$  of 70° [70°] relative to the roller axis 5.

Furthermore, the webs 3 have a rectangular formed cross section and are equipped with radially outward web sections 6 running parallel to the axis 5. Between neighboring webs 3 there are a plurality of radial inward pointing recesses 7. The webs 3 in the illustrated embossing roller have a dimension (height) of 0.2 mm pointing radially outward from the roller core 4, whereas the width of the recesses 7 amounts to 1.5 mm. The dimensions of the webs 3 and of the recesses 7 are unchanged across the roller surface of the embossing roller 1.

The lower embossing roller 2 also illustrated in Figure 1 cooperates with the upper embossing roller 1 in the embossing of the tissue article and has the same design—with the exception of a section 8 illustrated as an example—as was described above for the embossing roller 1. In other words, on the lower embossing roller 2 there are also webs 3 aligned at an angle  $\alpha$  of 70° relative to the roller axis 5', wherein between neighboring webs 3 there are a plurality of radially inward pointing recesses 7.

The section 8 shown as an example in Figure 1 does not have any web-like engravings and accordingly also does not have any recesses. Rather, the section 8 is designed such that the roller core 4' is not engraved therein.

As is indicated by the modification of the mantle of the lower embossing roller 2 illustrated in Figure 2, there are two non-embossed sections 8 and 8' distributed uniformly over the perimeter, so that in these sections 8 and 8' during the embossing of the layers to be embossed to each other in the manufacture of the tissue article, said layers are not embossed in these sections 8 and 8'. Therefore, in the embossed tissue articles there are no cohesive embossed zones present in the sections 8 and 8', so that here the tissue article will have a relatively large area which is particularly voluminous and soft.

This is also clearly expressed in Figures 3 and 4, which show the embossed tissue article in a top view (Figure 3) and in a cut-away view (Figure 4).

As indicated in Figures 3 and 4, the embossed article indicated overall by reference number 9 has a plurality of diamond-shaped embossed zones 10 which are located outside of the not embossed section 8. In this case, these cohesive embossed zones are produced in that radially outward extending webs from the two embossing rollers 1 and 2 (Figure 1) form the actual embossing gap during the embossing process, and these embossing zones 10 are positioned exactly in the middle when viewed across the thickness of the embossed article 9, as is clearly indicated in Figure 4. Due to this plurality of

diamond-shaped embossed zones 10, the two layers 11 and 12 shown as examples, are durably bonded together to form the tissue article 9.

The second design embodiment of an embossing roller will be explained in greater detail based on Figures 5 to 8.

Figure 5 shows schematically this second design embodiment of the embossing roller, and in contrast to Figure 1, Figure 5 shows only the lower embossing roller 2. This lower embossing roller 2 and an upper embossing roller cooperating with it (which is not shown) has on its surface a plurality of web elements 3', and of these web elements 3' only three are illustrated in Figure 5. In this case, between neighboring web elements there are a plurality of radially inward pointing recesses 7, and these recesses extend inward up to the roller core 4 of the roller 2. Furthermore, sequential web elements 3' are separated from each other by additional, radially inward pointing recesses 13, and these additional, radially inward pointing recesses 13 likewise extend up to the roller core 4. Due to these additional, radially inward extending recesses 13, the result is that the number of embossed zones is reduced in comparison to the number of embossed zones of the first design embodiment shown in Figures 1 to 4.

Furthermore, the embossing roller 2 shown in Figure 5 has a section 8 which does not have any engraving, as was already described with reference to the first design embodiment.

The lower embossing roller 2 shown in Figure 5 is used together with an upper embossing roller (not illustrated) for embossing of the tissue article, as is illustrated in principle in Figure 1 and is explained therein. In contrast to the upper embossing roller 1 shown therein, the upper embossing roller cooperating with the lower embossing roller 2 illustrated in Figure 5, has web elements 3' distributed uniformly across its entire embossing roller mantle, and sequential web elements 3' are interrupted by additional recesses 13 and neighboring web elements 3' are interrupted by the recesses 7, so that

accordingly the upper embossing roller is engraved as is indicated in Figure 5 for the engraved zones of the lower embossing roller 2.

As indicated in Figure 6 for the modification of the embossing roller mantle of the lower embossing roller 2, the lower embossing roller 2 has two not engraved sections 8 and 8', as was explained above for the first design embodiment based on Figure 2.

Figures 7 and 8 show a top view of the embossed tissue article (Figure 7) and a cut-away view of the embossed tissue article (Figure 8).

As is indicated in Figures 7 and 8, the embossed article denoted overall by reference number 9, has a plurality of diamond-shaped embossed zones 10 which are located outside of the not embossed section 8. In this case, these cohesive embossed zones 10 are produced in that radially outward extending webs from both embossing rollers form the actual embossing gap during the embossing process, and these embossing zones 10 are located exactly in the middle when viewed across the thickness of the embossed article 9, as is indicated clearly in Figure 8. Due to this plurality of diamond shaped embossed zones 10, the two layers 11 and 12 shown as an example are durably bonded to each other to form the tissue article 9.

In contrast to the first design embodiment of the tissue article embossed with the embossing roller shown in Figure 1, the embossed article shown in Figure 7 was embossed with the embossing roller presented in Figure 5 and has embossed zones 10 whose separation and density are much smaller than the spacing and the density of the embossed zones 10 generated with the first design embodiment, as is clearly seen by a comparison of Figures 3 and 7. This is because in the second design embodiment, the embossing rollers (Figure 5) have additional, radially inward extending recesses 13, so that in this case, the density of the embossing zones is reduced accordingly in the longitudinal direction of the embossed article.

The third design embodiment of the embossing rollers 1 or 2 illustrated in Figure 9 has an engraving which corresponds precisely to the pair of embossing rollers discussed above in conjunction with Figure 1. But in addition, the pair of embossing rollers 1 or 2 according to Figure 9, has spacer rings 14 and 14', and each embossing roller 1 or 2 has on its end a spacer ring 14 or 14'.

As is clearly indicated in Figure 9, the spacer rings 14 and 14' extend radially farther to the outside relative to the webs 3 by the amount  $h$ , which amounts to 0.015 mm in the illustrated design embodiment. The axial dimension  $d$  of these spacer rings 14 and 14 amounts to 50 mm.

In this case, these spacer rings 14 and 14' cause the engravings 3 of the upper roller 1 or of the lower roller 2 to be kept at a distance during the embossing process for manufacture of the tissue article, so that automatically the desired embossing pressure and the desired embossing gap size will be adjusted in the region of the embossing zones, without any complicated adjustment effort being needed. Surprisingly, since the wear on the spacer rings 14 and 14' essentially corresponds to the wear on the engraving designed as a web 3, by the positioning of such spacer rings 14 and 14' this required setting of the embossing pressure and of the embossing gap can be deferred for a longer period of time. This is important for the simplification and reproducibility of the embossing process.

Figure 10 presents a fourth design embodiment of the invented embossing roller, whereby in this case a pair of embossing rollers is shown which is composed of an upper embossing roller 1 and a lower embossing roller 2.

The upper embossing roller 1 is provided with an engraving designed as webs 3, and these webs 3 extend as an uninterrupted web line in a spiral shape across the surface of the roller of the upper embossing roller 1. The uninterrupted webs 3 are aligned at an angle  $\alpha$  of  $70^\circ$  relative to the roller axis 5 in the design embodiment shown in Figure 10.

Furthermore, the webs 3 having the rectangular cross section are also provided with radially outward web sections 6 running parallel to the axis 5. Between neighboring webs 3 there are a plurality of radially inward pointing recesses 7. The webs 3 in the illustrated embossing roller have a dimension (height) of 0.2 mm pointing radially outward from the roller core 4 in the illustrated embossing roller, whereas the width of the recesses 7 amounts to 1.5 mm. The dimensions of the webs 3 and of the recesses 7 are invariant across the roller surface of embossing roller 1.

In addition, the lower embossing roller 2 illustrated in Figure 10 cooperates with the upper embossing roller 1 during the embossing of the tissue article, and with the exception of the spacing of the neighboring webs, which was also designated as the width of the recess 7 above, has the same structure as was described above for the embossing roller 1. In other words, on the lower embossing roller 2 there are also webs 3 aligned at an angle  $\alpha$  of 70° relative to the roller axis 5', wherein between neighboring webs 3 there are a plurality of radially inward pointing recesses 7. In this case, the width of the recesses 7 is 2.85 mm, which corresponds to the axial spacing of neighboring webs.

As is evident in the top view of the embossed tissue article shown in Figure 11, the embossed article denoted overall by reference number 9 has a plurality of diamond shaped embossed zones 10. In this case, these cohesive embossed zones 10 are produced in that radially outward protruding webs of both embossing rollers 1 and 2 (Figure 10) form the actual embossing gap during the embossing process, and these embossing zones 10 are located precisely in the middle when viewed across the thickness of the embossed article 9. Due to this plurality of diamond shaped embossed zones 10, the two layers shown as an example are durably bonded together to form the tissue article 9.

Because the spacing of neighboring webs 3 of the lower roller 2 is greater than the spacing of neighboring webs 3 of the upper roller, the number of embossed zones 10 distributed across the width of

the embossed tissue article 9 (Figure 11) can be reduced in comparison to the first design embodiment, as is clearly indicated by a comparison of Figures 3 and 4.

### Claims

1. Embossing roller for the production of tissue articles, in particular for the production of paper tissues, hygienic articles, kitchen towels or napkins, characterized in that two engraved rollers (1; 2) together form a pair of embossing rollers, wherein each roller (1; 2) has on its surface at least one engraving (3, 6) protruding above the roller surface, and that the rollers (1; 2) are aligned with respect to each other so that the embossing gap needed for the common embossing of the layers (11, 12) forming the tissue articles (9) is formed by the mutually aligned, radially outer engraving sections (6) of the rollers (1; 2).

2. Embossing roller according to Claim 1, characterized in that each roller has an engraving (3, 6) such that a plurality of webs (3) located on the roller surface are covered.

3. Embossing roller according to Claim 2, characterized in that the webs (3) are positioned in a spiral shape on the roller surface of each roller (1; 2).

4. Embossing roller according to one of Claims 2 or 3, characterized in that each web (3) is formed from a plurality of web elements (3') wherein sequential web elements (3') are separated from each other by radially inward pointing recesses (13).

5. Embossing roller according to one of the preceding Claims, characterized in that two embossing rollers (1, 2) equipped with different engravings, form the pair of embossing rollers, wherein the engravings are formed as webs (3) located on the roller surface, and that the axial separation (7) of the webs (3) located on the surface of the one embossing roller (2) is greater than the axial separation (7) of the webs (3) located on the surface of the other embossing roller (1).

6. Embossing roller according to Claim 5, characterized in that the axial separation (7) of the webs (3) on the roller surface of the one embossing roller (2) is greater by a factor of 1.5 to 2.5 than the axial separation (7) of the webs (3) of the surface of the other embossing roller (1).

7. Embossing roller according to one of Claims 1 to 4, characterized in that two embossing rollers equipped with identical engravings form the pair of embossing rollers.

8. Embossing roller according to one of the preceding Claims, characterized in that each roller (1; 2) has at least one spacer ring (14, 14') extending across the circumference, wherein the spacer ring (14, 14') extends farther out radially relative to the engraving (3, 3', 6), and the at least two spacer rings (14; 14') provided on each roller (1; 2) are positioned so that the spacer rings (14, 14') contact each other during the embossing.

9. Embossing roller according to Claim 8, characterized in that each spacer ring (14, 14') extends radially farther outward by between 0.005 mm and 0.1 mm relative to the engraving.

10. Embossing roller according to one of the preceding Claims, characterized in that the engraving formed as a web (3) for each roller (1; 2) has a plurality of web sections (6) running radially outward and parallel to the axis.

11. Embossing roller according to one of the preceding Claims, characterized in that each web (3) has an axial width of between 0.2 mm and 1.4 mm, preferably an axial width of 0.5 mm to 0.9 mm.

12. Embossing roller according to one of the preceding Claims, characterized in that the recess (7) located between neighboring webs (3, 3') has an axial dimension of between 1.0 mm and 10.0 mm, in particular between 1.2 mm and 1.5 mm.

13. Embossing roller according to one of the preceding Claims, characterized in that the radial height of each web (3, 3') varies between 0.1 mm and 1.5 mm.

14. Embossing roller according to one of the preceding Claims, characterized in that the spiral shaped webs (3) provided on the roller surface of each roller (1; 2) are aligned at an angle  $\alpha$  between 35° and less than 90°, relative to the roller axis (5, 5').

15. Embossing roller according to one of the preceding Claims, characterized in that the web (3, 3') has a rectangular cross section.

16. Embossing roller according to one of the preceding Claims, characterized in that at least one roller (2) of the roller pair (1; 2) has at least one section (8) in which the roller surface is provided with no engraving, and this section (8) is located between the plurality of webs (3, 3') according to a predetermined pattern.

17. Embossing roller according to Claim 16, characterized in that the non-engraved section (8) accounts for between 20% and 70% of the roller surface of the particular roller.

18. Embossing roller according to one of the preceding Claims, characterized in that the rollers (1; 2) have a roller diameter of between 100 mm and 1000 mm, preferably between 200 mm to 500 mm.

19. Embossing roller according to one of the preceding Claims, characterized in that on the roller surface there is an engraving (3, 3') such that the embossed zones created thereby take up a surface area of between 0.1% and 60%, relative to the surface area of the embossed tissue article.

20. Embossing roller according to one of the preceding Claims, characterized in that on the roller surface there is an engraving (3, 3') such that the number of embossed zones (10) created thereby varies between 5 and 90, relative to 1 cm<sup>2</sup> surface area of the embossed tissue article (9).

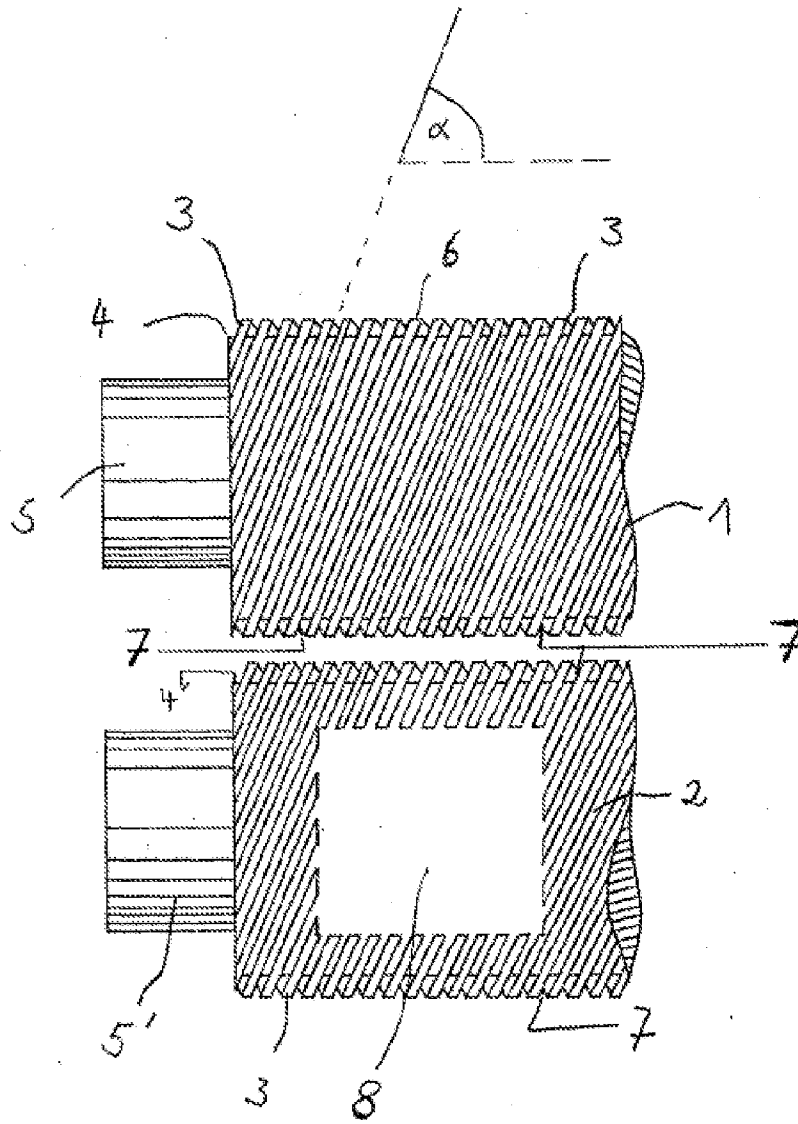


FIG. 1

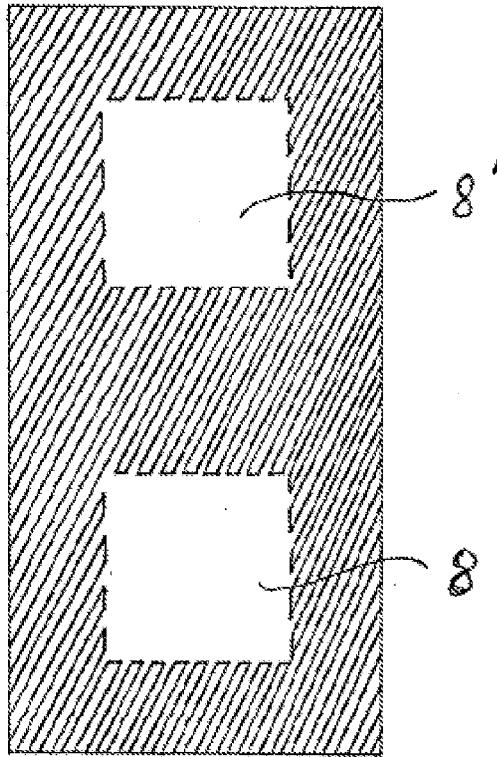
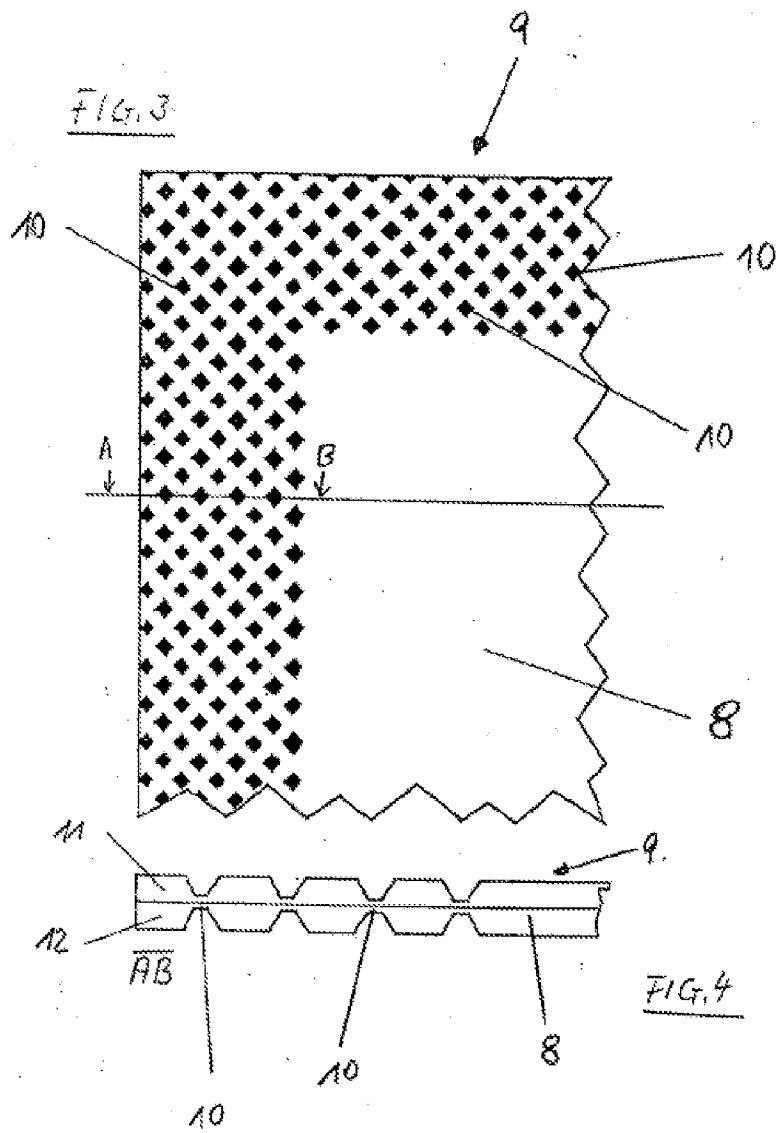


FIG. 2



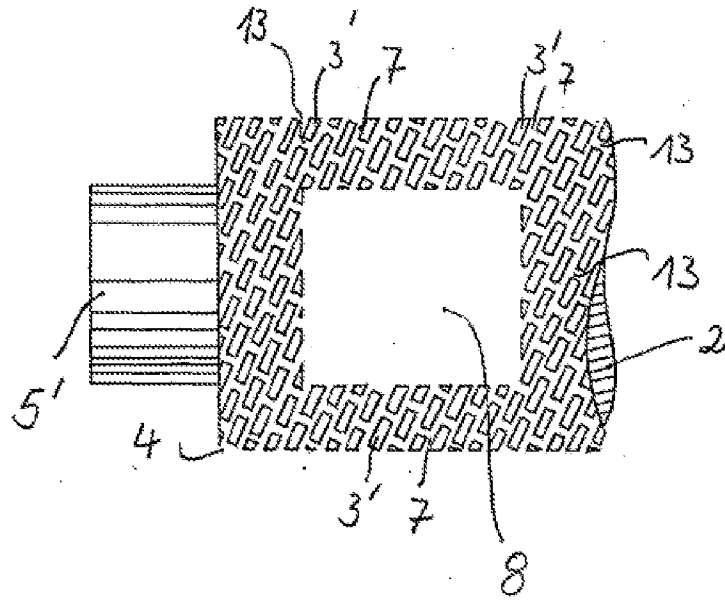
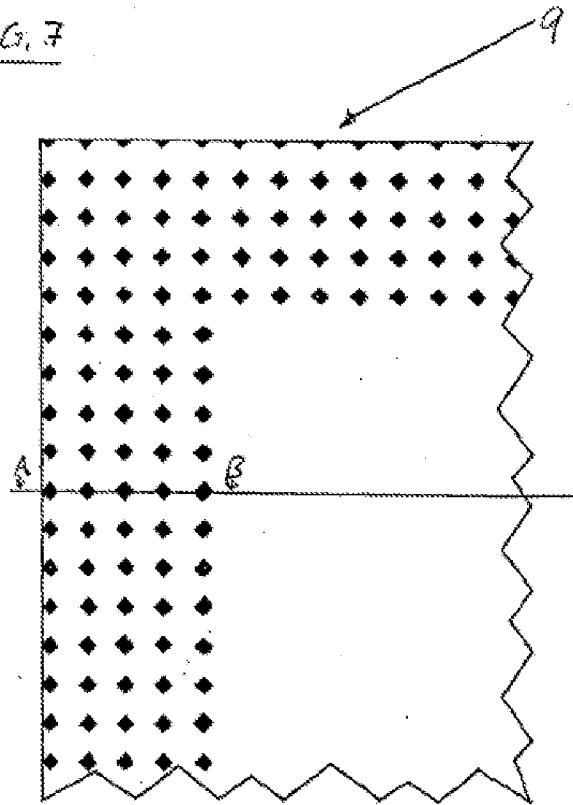


FIG. 5

FIG. 7



AB

FIG. 8

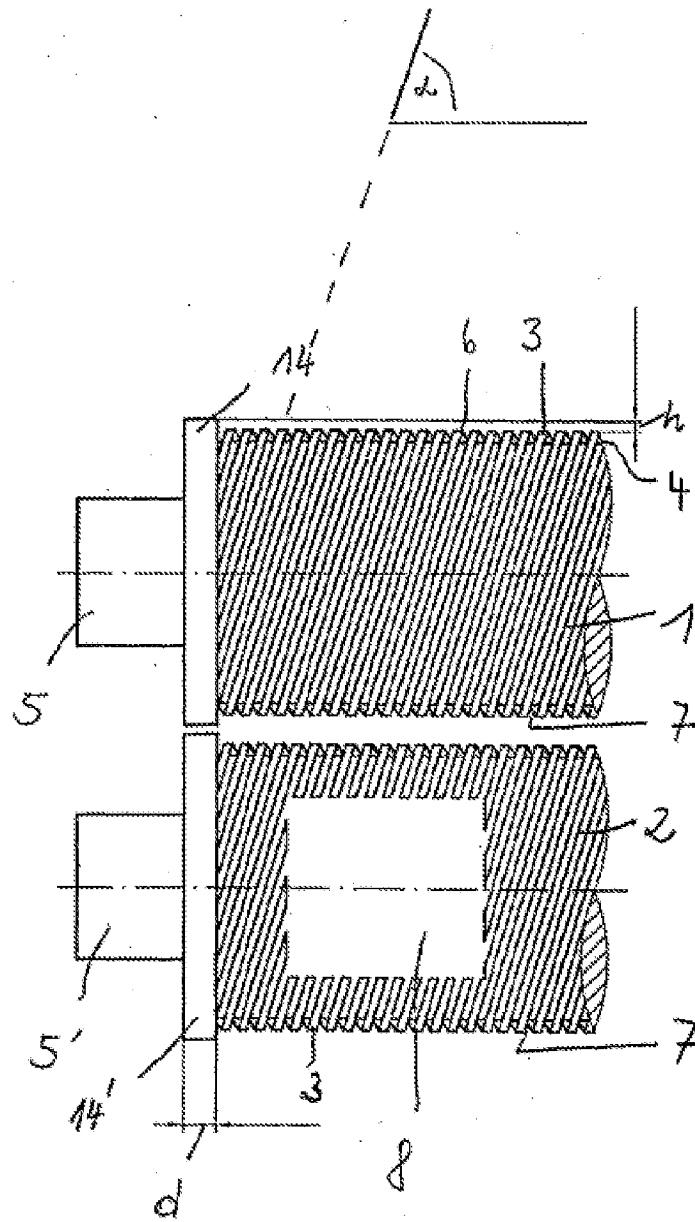


FIG. 9

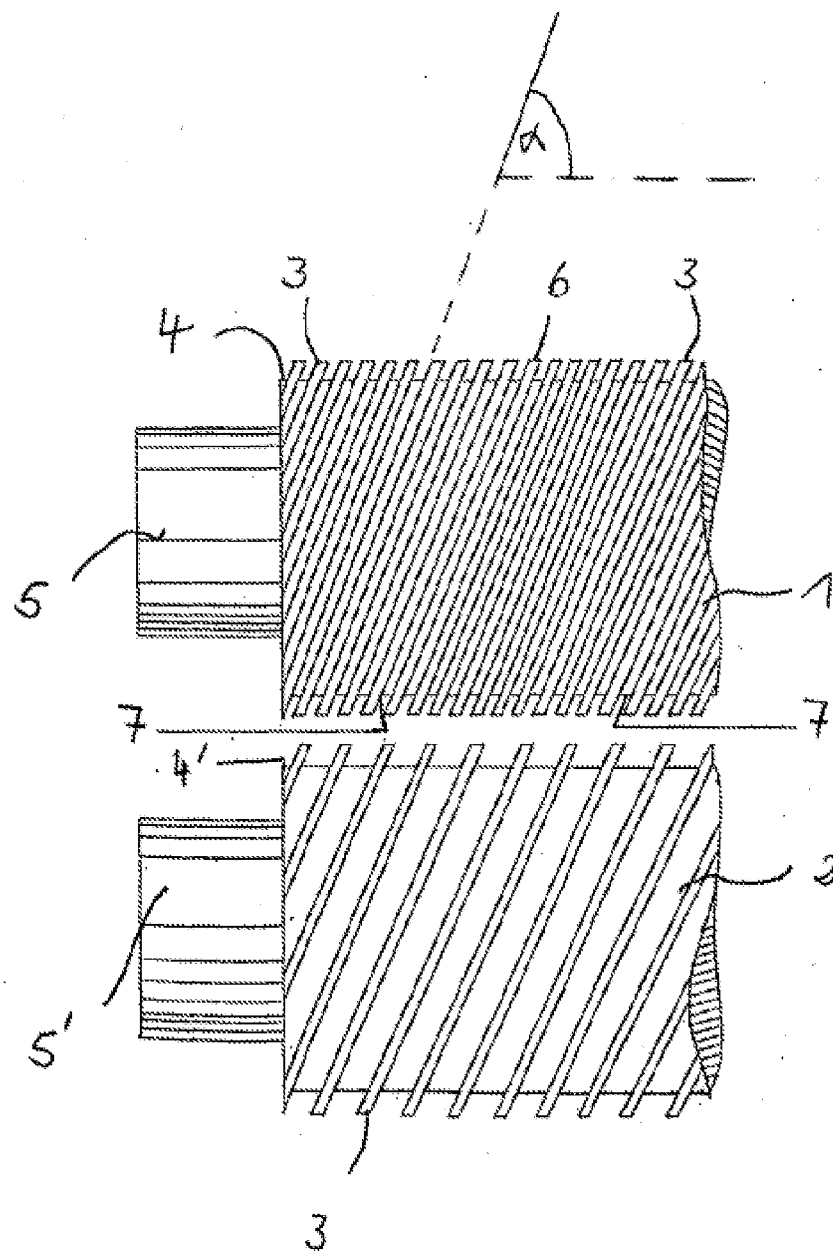


FIG. 10

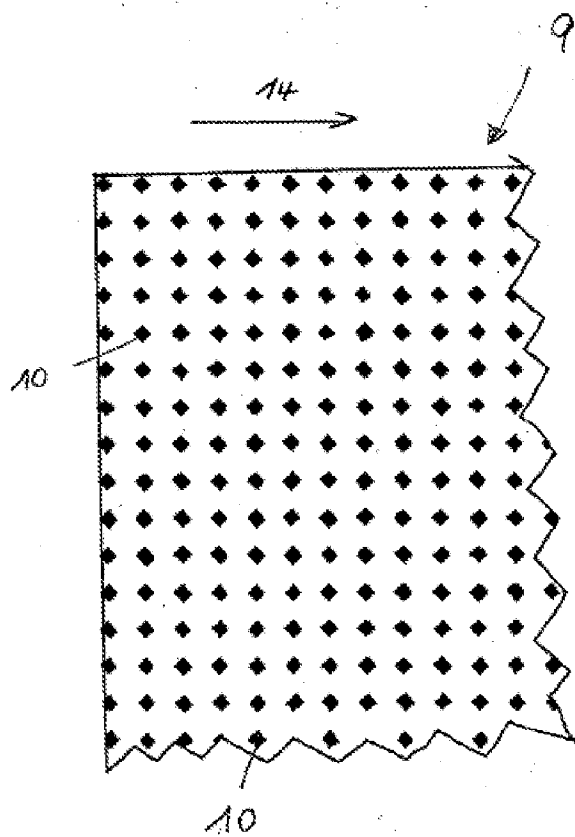


FIG 11